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like sets, numbers, propositions, facts, and truth-values, or (b) to nonparticular, 'predicative' entities like properties, relations, functions, and universals.

2. Issues Relating to Nominalism

As this last claim indicates, however, there are in fact two quite separate issues to be considered here.

2.1 Universals

The first has its origins in ancient debates concerning universals and particulars, the one and the many. In this connection there arise the ontological, logical, linguistic, and epistemological problems to do with the distinction between single, individual items, on the one hand, and, on the other, the shareable attributes or general characteristics they have in common. Nominalism of this sort first emerged in the thought of Roscelin, Abelard, and William of Ockham as a rejection of the Platonic doctrine that universals enjoy real, objective existence. The impetus towards nominalism of this kind has a number of sources. One is perhaps a straightforward ontological intuition, to the effect that reality just is particular, and that there is something fishy about the very idea of a general or universal entity. Many nominalists were motivated, for instance, by their failure to see how a universal could be simultaneously and wholly present in a number of different objects, without becoming divided in the process. Another historically important impetus came with the emergence in the Middle Ages of radical empiricism; for if all knowledge and understanding originates in sensory experience, and if such experience only ever provides data that are irreducibly particular, then the claim that we possess any knowledge or understanding of things that are nonparticular can appear highly problematic. Finally, for those who accept the desirability of ontological parsimony—as formulated for instance in the principle known as Ockham's Razor ('entities should not be multiplied beyond necessity')—there is a requirement that universals be dispensed with, if this can be done coherently (see *Ontology*).

2.2 Abstract Objects

The second issue associated with the topic of nominalism has a shorter history than the first, having received clear formulation only in works of post-Fregean philosophy (see *Frege, Gottlob*). The issue concerns the existence of, and the indispensability of our reference to, abstract objects. An abstract object (a proposition, say, or a set) is a particular object, but one that possesses neither spatio-temporal characteristics nor causal powers. This is a different issue from the first, because abstract objects are themselves particular individuals: they do not have instances; they do not inhere in substances; and so the problems concerning the nature of universals, and the relation of universals to the particulars that instantiate them have no special pertinence with respect to them.

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D. Bell

Nominalizations

Nominalizations can be looked upon from various perspectives. Syntactically, nominalizations are constructions that have properties of noun phrases but are headed by an element that is to some extent verbal. The word 'headed' in this definition refers, of course, to semantic headedness; the *head* meant is the nominalized predicate. Whether nominalizations have a syntactic head, and which one, is quite another question. Indeed they have been analyzed as exocentric constructions.

The vagueness in the above definition is indicative of the enormous range of constructions which have been called nominalizations in the linguistic literature. At the one extreme, there are cases where the head noun is related to a verb etymologically, but where the construction itself is a typical noun phrase (e.g., *applications for a scholarship* . . .). At the other extreme, there are languages in which full clauses receive some kind of marker typical of noun phrases, such as case, but have no nominal characteristics whatsoever in their internal constitution (an example is given from Quechua in (18) below). If only the two extremes existed, nominalizations would be of little interest syntactically: the first type could be described as an ordinary noun phrase, and the second type as a clause in disguise. The problem is, however, that there are a number of cases in between. Therefore, it is better to discuss a number of individual properties of nominalizations separately.

Before this, it should be pointed out that there is also a purely morphological side to nominalizations: through a number of processes verbal stems or roots can be turned into nouns or noun-like elements. These processes may or may not be productive. The morphological issue will be considered first.

1. Morphology

In many languages, nouns can be derived from verbs through some morphological process of derivation. The meaning of the resulting nouns is generally related to that of the corresponding verbs, but the relationships can be very diverse and are far from regular. 'Agentive' nominalizations are often found:

- buy/buyer
 hunt/hunter (1)

Through a process of semantic specialization, English *-er* nominalizations have acquired other meanings in addition:

- occupation: bake/baker
 habitual: loaf/loafer
 instrument: cut/cutter
 location: sleep/sleeper (2)

A second type of nominalizations is 'action' or 'process' nominalizations. These can take very diverse forms in English:

- hunt/hunt
 sell/sale
 involve/involvement
 destroy/destruction

Often these action or process nominalizations can also be interpreted as ‘result’ or ‘state’ nominalizations. Thus *sale* can refer to the act and to the result of selling something.

The distinction between agentive and action nominalizations is not limited to English, and the processes of semantic specialization and shift alluded to are more general as well. Nonetheless, other languages may make other distinctions in addition. In the Andean American Indian language Quechua, for instance, there are agentive nominalizations formed with *-q*, and these can undergo specialization and refer to occupations or people in the habit of doing something:

- | | | |
|-------------|---|-----|
| suwa-q | 'someone in the act of stealing;
thief' | (4) |
| wacha-chi-q | 'someone in the act of helping to
give birth; midwife' | |
| macha-q | 'someone in the act of drinking;
alcoholic' | |

Instrumental and locational nominalizations are not derived in the same way, however, in Quechua. These are formed with one of the suffixes used for action nominalizations:

- | | | |
|-----------|--|-----|
| puqlla-na | 'playing (some time);
plaything, toy' | (5) |
| puñu-na | 'sleeping (some time); bed' | |

With action nominalizations, a distinction is made between unrealized actions, realized actions, and actions at some unspecified moment:

- | | | |
|----------|-----------------------|-----|
| puñu-na | 'sleeping some time' | (6) |
| puñu-sqa | 'having slept' | |
| puñu-v | 'sleeping in general' | |

Result nouns can emerge from realized action nominalizations:

- macha-sqa 'having drunk; a drunk' (7)

Comrie and Thompson (1985), in their typological survey, mention languages such as the Californian American Indian language Wappo, which has a special instrumental suffix *-(e)ma*:

- yoʔ-/yok'ema 'to sit/chair' (8)
kač-/kačema 'to plow/plow'

Undoubtedly other languages possess yet other suffixes to mark specific types of nominals, but the two main types are agentive and action nominals.

In addition to the issue of the lexical semantics of nominalization, there is the question of productivity and regularity. This, in turn, has important consequences for the status of nominalization in the grammar: that is, whether it is lexical or syntactic. In early transformational grammar (e.g., Lees 1960) there was no place for lexical operations. Consequently, all nominalizations were thought of as syntactic, and (9b) was assumed to have been derived from (9a) via a complex set of transformations:

- The enemy destroyed the city. (9a)
- the enemy's destruction of the city (9b)

In an article which heralded the advent of generative morphology, Chomsky (1970) proposes a different solution. He considers three patterns:

- the enemy's destruction of the city (10a)
- the enemy's destroying the city (10b)
- the enemy's destroying of the city (10c)

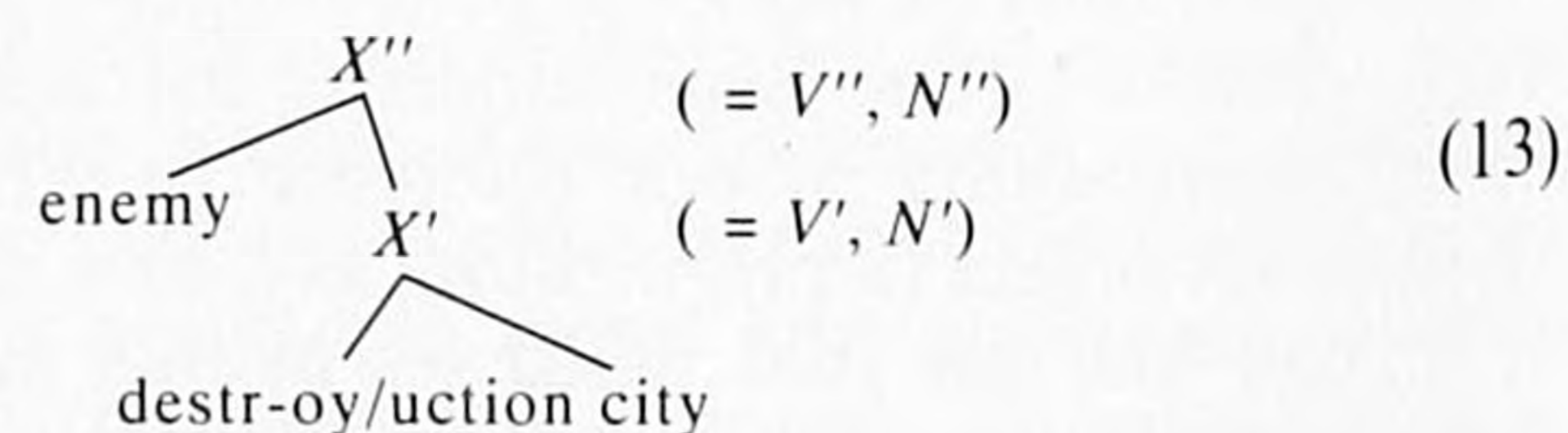
Pattern (10a) cannot be transformationally derived, in Chomsky's view, for a number of reasons. First, there is a wide range of nominalization processes in English, some of them quite irregular: *(at)ion*, *-ment*, *-al*, *-age*, *-y*, stress shift, etc. and it is impossible to predict which verb takes which affix. For example, English does not have **arrivation*, **computage*, etc. Second, it is not always possible to predict the meaning of the resulting nominalization. *Revolution* means both 'process of revolving' and 'political upheaval'; *deeds* are not just anything one does, but acts that are for some reason significant. Third, some verbs do not have a lexical nominalization associated with a sentence in which they may be used for example:

- *John's amusement of the children
with his stories. (11a)
- *John's easiness to please (11b)

Finally, lexical nominalizations behave like ordinary nouns: they can be pluralized, take *of*-phrases, etc.:

- John's three proofs of the theorem
- (12)

For all these reasons, Chomsky preferred having an element such as *destruction* generated directly in the lexicon, while keeping a syntactic derivation for gerunds as in (10b) and keeping an open mind with respect to the mixed type (10c). The fact that there is still a form and meaning relation with the verb *destroy* can be accounted for through a lexical linking rule, which would relate the two lexical entries *destroy* and *destruction* morphologically, or through having a joint entry for both words. Hence the need for a theory of morphology in generative grammar (see *Morphology*). The noun and the verb can participate in structures which are roughly similar, as can be seen schematically in (13):



The similarity was expressed in the formalism of *X-Bar Syntax* in Chomsky (1970): all categories project syntactic structure, and the projected constituents have the same category as the element from which they are projected. Similarities between the projections of nouns and verbs, as is the case in (9a) and (9b), can be expressed by referring to the level of projection (X' , X''). Thus, the semantic object, *city*, can be seen as the daughter of X' , and the semantic subject, in (9) and (13) *enemy*, often termed the 'external argument,' as the daughter of X'' . Category specific rules then determine the precise form in which these arguments are realized.

2. Agentive Nominalizations

In many languages, agentive nominals can head a participle clause that can modify a nominal head, and hence function as a 'relative clause.' The examples here are from Quechua (14) and from Turkish (15):

[[hamu- q] runa- ta] riqsi-ni (14)
come AG man AG know I
I know the man who comes.

[[gel- en] adam- i] gör- düm (15)
come AG man AC see PA I
I saw the man who comes.

In both cases the agentive participle precedes the noun phrase it modifies, in the position of the adjective. The subject of the relative clauses, coreferential with the head, is unspecified, and there normally is no subject agreement marker in the clause.

The head noun is marked for the case corresponding to the noun phrase, but when the head noun is lacking, the participle itself is case-marked:

[hamu- q- ta] riqsi-ni (16)
come AG AC know I
I know the one who comes.

Finally, note that (14 and 16) are not tensed: the ordinary past/present/future distinction cannot be made in Quechua. It is possible, however, to mark the participle for aspect:

[hamu-sha-q] runa- ta] riqsi-ni (17)
come DUR AG man AC know I
I know the man who is coming (right now)

3. Action Nominalizations

It is another type of nominalizations, however, that has drawn most attention in the linguistic literature: action nominalizations (Comrie 1976; Comrie and Thompson 1985; Koptjevskaja-Tamm 1988). Here the problem of the possible resemblance between the projection of the verb and that of the nominal is most acute. A number of features can help keep the two types of structures apart: (a) the way in which the arguments, subjects, and objects, are realized; (b) the possibilities for tense, negation, and other forms of modification; (c) possible nominal marking of the head: case, plural, etc.

3.1 Subject Properties

A first diagnostic feature in distinguishing different types of structures is the status of the 'subject,' the external argument: the possible case markings, whether the subject is obligatory, whether it can remain phonetically unrealized.

With respect to case marking, there are a number of different possibilities. In clause-like action nominalizations such as those of Quechua, the subject is marked either nominative (0) or genitive (-pa):

[{xwan-pa} hamu-sqa-n-ta] yacha-ni (18)
{xwan-0}

Juan GE/0 come NOM 3 AC know I

I know that Juan has come

There is evidence that when the subject is nominative in Quechua the object is a nominalized clause. Thus nominalized clauses with nominative subjects may occur in object—(18)—but not in subject position—(19):

[{xwan -0 } hamu-sqa-n] allin-mi (19)
{xwan -pa}

Juan GE come NOM 3 good AF

That Juan has come is good

The reason is presumably that in subject position only noun phrases, but not clauses, can occur. In Quechua noun phrases, the constituent-initial possessor is marked genitive as well.

In other languages, the understood subject is marked by a preposition or oblique case marker. An illustration is Hebrew, for example, (20a) and (20b):

dxiyato šel dan et hahacaa (20a)
reject-NOM-MASC of Dan AC the-offer
Dan's rejection of the offer.

dxiyata šel hahacaa al ydey dan (20b)
reject-NOM-FEM of the-offer by Dan
Dan's rejection of the offer.

While in (20a) the understood subject is marked genitive (and the object accusative), in (20b) the genitive is found on the object and the subject introduced by a preposition meaning 'by.' Clearly the Hebrew action nominals of type (20b) are much more similar to noun phrases than the Quechua ones.

In English, which provides examples such as, *I very much dislike him/his singing*, the matter is complicated by the fact that there is only a limited case system. For *his* the issue is clear; a genitive is quite expected here. For *him*, however, various analyses have been proposed; it may well be that English displays a kind of inherent, absolute case here, similar to expressions like *Him?! My new stepfather?!*

A second property of subjects that can be used as a diagnostic feature is obligatoriness. In languages such as English the subject is obligatory:

*Destroyed the city (21)

Typically, the subject of an action nominal can be absent—(22a)—just as an ordinary noun can have a possessor or not—(22b):

I dislike [unnecessary destruction of property] (22a)

mother/Mary's mother (22b)

As might be expected, the subject of Quechua action nominals is obligatory, given their other clause-like properties:

{hamu-sqa-n-ta} yacha-ni (23)
{*hamu-sqa -ta}

The subject—realized here as the agreement marker *-n*—must be present.

An issue which needs much further investigation is whether it is possible to have a phonetically null subject with indefinite reference (often termed an uncontrolled PRO, that is, a pronominal element the reference of which is not determined, 'controlled' by another noun phrase) in the subject position of a nominalization. In (24a) this is quite possible, but for (24b) the matter is less clear:

[PRO swimming in the locks] is dangerous (24a)

[Such ?PRO neglect of one's own kin] is despicable. (24b)

To what extent does a phrase like 'one's own' demand an antecedent?

3.2 Object Properties

With the understood object, similar options are available. In a language such as Turkish (25), the object in a more clause-like action nominal is marked accusative *-i* (when definite), while in Russian (26) more noun phrase-like action nominals genitive case occurs:

Süleyman [Ahmet-in ev -i yap-tığ-ın-ı] (25)
Suleyman GE house AC build NOM1 3 AC
bil-i-yor
know PR3
Suleyman knows that Ahmet built the house.

napolnenie bassejna vodoj (26)
filling swimming-pool-GE water-INSTR
the filling of the swimming-pool with water

A second property of objects that may distinguish different types of action nominals is whether they can have a definite reference or not. In Dutch, expressions such as (27a) are quite frequent, but (27b) is odd:

[mosselen eten] is gezond (27a)
To eat mussels is healthy.
?[de mosselen eten] is verboden (27b)
To eat the mussels is forbidden.

It would seem that in clause-like action nominals noun phrases with definite reference are possible, while in noun phrase-like action nominals they are more restricted, as they are in nominal compounds.

3.3 Adverbial and Adjectival Modification

A third diagnostic feature is the type of modification occurring. Adjectives are found in noun phrases, and adverbs in clauses. The following contrast (28, 29) illustrates this:

They had a strong disagreement about capital punishment. (28)
John's disagreeing so strongly about capital punishment has not made things any easier. (29)

Similar data can be obtained from many languages. What they show is that in some nominalizations, like the one in (29), the structure of the verb phrase is sufficiently intact to permit an adverb. There is a relation between adjective modification and the possibility for the nominalization of being pluralized:

three disagreements (30a)
*three John's disagreeings strongly (30b)

Similar phenomena are found in other languages as well, although it should be mentioned that another potential diagnostic for nounhood, case marking, fails. Consider once again a Turkish example (31) similar to (25) above:

ahmet-in ev-i yap-tığ-ın-ı bil-i-yor-um (31)
Ahmet GE house AC build NOM1 3 AC know PR 1
I know that Ahmet has built the house.

Here the form *yap-tığ-ın-ı* 'that (s)he has built' is verb-like enough to be able to assign accusative case to its object *ev-i* 'house AC,' but noun-like enough to carry accusative case *-ı* itself. Indeed, it is suspected that many cases of clause-like nominalizations involve nominalization precisely so that the clause-final verb can carry the case marking assigned to it by the matrix verb.

3.4 Tense and Aspect

With respect to tense and aspect distinctions, the picture is quite complex. The full range of tense and aspect distinctions is generally lost, and in many language lexical, noun phrase-like nominalizations show no aspectual distinctions. An exception is Polish, for which language Comrie and Thompson report the following pair contrasting in perfective/imperfective aspect:

Czytanie tej książki dało dużo radości (32a)
The reading of this book gave much pleasure.
Przeczytanie tej książki dało dużo radości (32b)

The perfective meaning of (32b) is that here the act of reading is envisaged in its totality, rather than as an ongoing process.

Quechua has maintained some tense distinctions in action nominals, which do not correspond to the past/present/future opposition of the main verb-tense paradigm, but to a distinction between realized (past/present) and unrealized actions:

hamu-na-n-ta yacha-ni (33a)
come NOM 3 AC know I
I know that (s)he will come.
hamu-sqa-n-ta yacha-ni (33b)
come NOM 3 AC know I
I know that (s)he comes/has come.

Notice that in English as well only the perfect tense can be marked in gerunds (34):

Mary's having criticized the thesis has caused some unease. (34)

3.5 Negation

A final feature that may be used to distinguish different types of nominalization is negation. Noun phrase-like nominalizations often cannot be negated, except by some nominal prefix:

*the not destruction of Rome (35a)
?the nondestruction of Rome (35b)

In Quechua, it is possible to negate nominalizations, but the marking is not the full negation of a finite clause:

mana hamu-na-n-ta yacha-ni (36a)
not come NOM 3 AC know I
I know that (s)he will not come.
mana hamu-nqa-chu (36b)
not come 3FU NEG
(S)he will not come.

Notice in (36b) that there is both *mana* 'not' and the negative particle *-chu*, while in (36a) *-chu* is lacking. The reason is, presumably, that *-chu* forms part of the system of evidentials and finite tense markers, which can not form part of a nominalization.

3.6 Conclusion

On the basis of such features as the ones described in Sect. 3.1 to 3.5 it is possible to characterize a wide variety of nominalization types. It might be hoped that there would be some system to this variety, such as the one proposed by Lefebvre and Muysken for Quechua. They claim that nominalizations in that language are very mixed in their

properties at their core, the nominalized verb, but that further up in the projection they become either more noun phrase-like or more clause-like. Other languages, like Turkish or Hebrew, show quite different patterns, however. So far, no one has succeeded in providing a coherent and unified analysis of action nominalizations, taking into account a sufficiently large sample of languages.

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P. Muysken

Nonacoustic Measurement of Speech

Until the 1990s, direct measurement of the vocal tract was reminiscent of the six blind men and the elephant. Just as each blind man deduced the entire elephant from a single part, direct measurement techniques have tended to access single parts of the vocal tract. A further problem was that introducing a measuring device into the mouth often made it difficult or impossible to speak. Thus the instrument might distort the very event it intended to measure. Physiological measurements have improved at an extraordinary pace. Imaging techniques have emerged on the scene and are beginning to revolutionize the way the vocal tract is viewed by providing recognizable images of structures deep within the pharynx. Point-tracking systems are transforming ideas about coarticulation by revealing inter-articulator relationships that could only be addressed theoretically in the past.

This paper considers three types of nonacoustic instruments for measuring speech physiology: imaging techniques, point-tracking techniques, and impedance transduction.

1. Imaging the Vocal Tract

The internal structures of the vocal tract are difficult to measure without impinging upon their normal movement patterns. Imaging techniques overcome that difficulty because they measure internal movement without directly contacting the structures. Three well-known imaging techniques have been applied to speech research: computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound. Imaging systems provide very different information from other physiological measures, namely, the shape and position of the entire imaged structure, rather

IMAGING TECHNIQUES

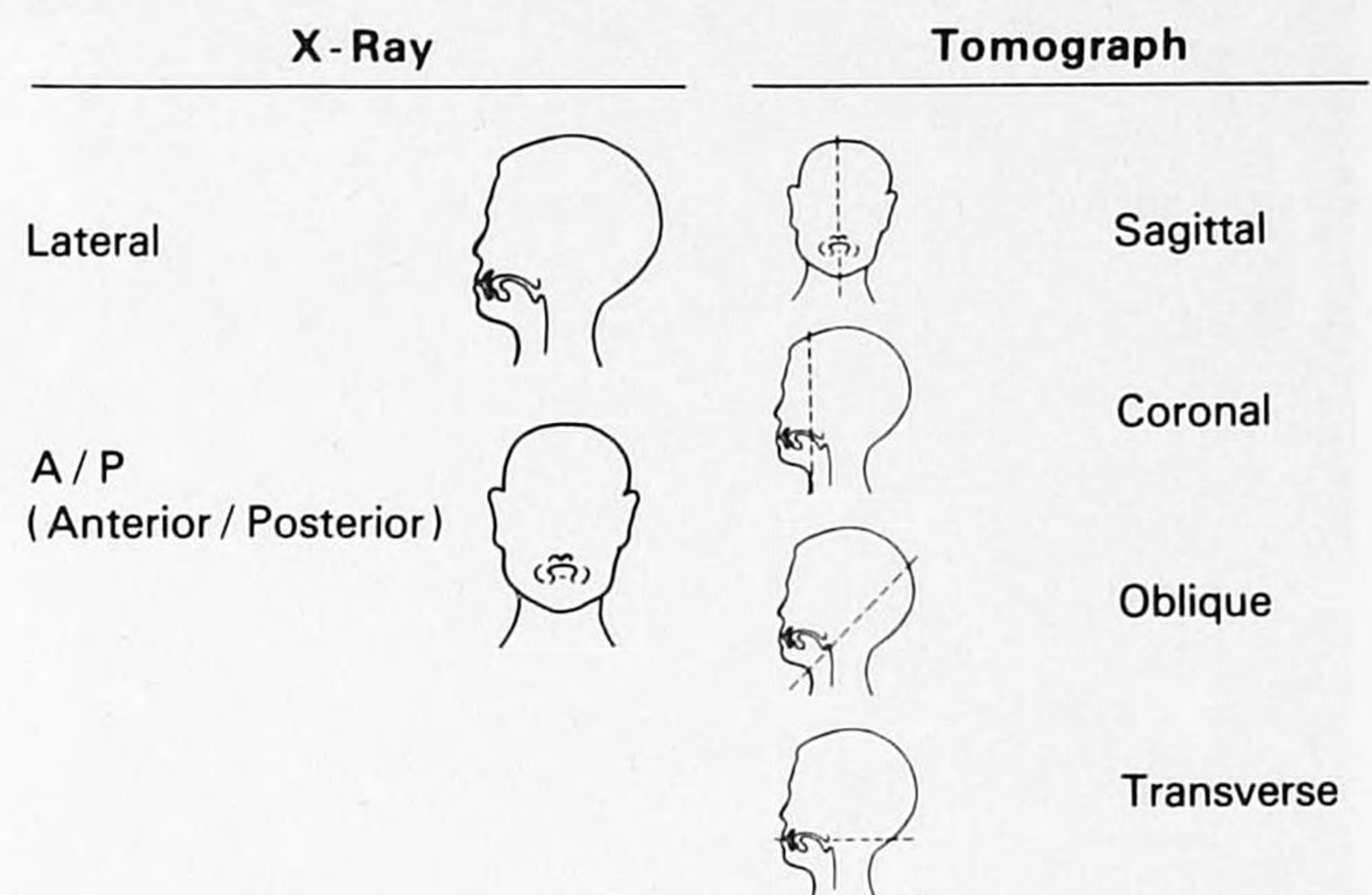


Figure 1. Scan types used in through-transmission and tomographic imaging. There are two X-ray angles contrasted with four tomographic scanning planes.

than a single point on the structure. The imaging techniques described below create images in a fundamentally similar way. They construct a tomography, or slice of tissue, by projecting a thin, flat beam through the tissue in a single plane.

In order to interpret imaged data, one must learn the four tomographic planes used in imaging (see Fig. 1). They are: sagittal, coronal, oblique, and transverse. The midsagittal plane is a longitudinal slice, from top to bottom, down the median plane, or midline, of the body (dashed line). The parasagittal plane is parallel to the midline of the body but off-center. The coronal plane is also a longitudinal slice. It is perpendicular to the median plane of the body. The oblique plane is inclined between the horizontal and vertical planes. Finally, the transverse plane lies perpendicular to the long axis of the body, and is often called the 'transaxial plane,' or even just the 'axial plane.'

1.1 Computed Tomography (CT)

The first tomographic technique of interest is computed tomography (CT). CT uses X-rays to image slices (sections) of the body. Fig. 2 depicts a CT scanner. The scanner rotates around the body, taking multiple images, at different angles, of a single section of tissue. A computer then creates a composite, including any structures that were visible in some scans but obscured in others. Fig. 3 shows a transverse section CT of the oropharynx at rest. Bone appears bright white in the image. The jaw can be seen at the top of the image, and a vertebra at the bottom. The hyoid bone is horseshoe shaped, in the middle of the image. The air in the vocal tract appears black, and the epiglottis can also be seen within the vocal tract. The tongue and other soft tissue are gray. CT can image soft tissue more clearly than X-ray because it produces a composite X-ray. By digitally summing a series of scans, the composite section has sharper edges and more distinct tissue definition.

CT has three major limitations. The first is time. Most CT scans take 2.5 seconds per frame, too slow for real-time speech. The newest CTs can take several scans per second, so future technology may eliminate this problem. The second